

Determination of ^{228}Ra in natural waters via Diphonix Resin

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Radium is a natural radionuclide that is of particular interest for oceanographers as it may lead to an understanding of various mobilization processes in the ocean. The main source of Ra in seawater is remobilization from sediments through its parent Th that is scavenged from the water by particles due to its very insoluble nature. Rivers constitute a minor source of Ra to the oceans except in areas adjacent to major rivers. Studies of Ra isotopic concentrations and ratios in the ocean can provide information about mixing processes and groundwater discharge into the ocean. Radium isotopes are also of concern from an environmental monitoring point of view.

According to previous work in our laboratory, ^{228}Ra may be measured by LSC after chromatographic separation by Actinide Resin using two columns, the first to remove actinides and the second to isolate ^{228}Ac , the direct daughter of ^{228}Ra . The purpose of the present work is to evaluate the use of Diphonix resin that would make the analysis much less expensive. Our approach uses Diphonix Resin for removal of naturally occurring actinides while radium passes through. The load/rinse solution from the first column is then stored for at least 30 hours for ^{228}Ac ingrowth. The ^{228}Ac , which will be in equilibrium, may then be easily isolated by passing through a second Diphonix column.

The general approach of the work was to establish the procedure of separation of Ra via MnO_2 co-precipitation from the water sample, and then Ac isolation using chromatographic separation of Ac via two Diphonix columns, followed by LSC measurement of the Ac eluted fraction (Figure 1). As an alternative, we also investigated using one Diphonix column, and then preparing a beta source by co-precipitation with CeF_3 followed by Gas Flow Proportional Counting (GFPC) measurement (Figure 2).

Ba-133 may be used as a tracer of Ra up until the point where Ac is separated from ^{228}Ra . We found that 10 mL of 2M HCl is enough to rinse the Ra/Ba fraction from a Diphonix Resin (1 cm diameter Kontes borosilicate glass column; 2 mL wet resin volume, preconditioned with 10 mL 2 M HCl).

Ac-228 may be eluted from the Diphonix column with 10 mL of 1M HEDPA, which may then be combined with Ultima Gold AB cocktail, and measured by LSC.

Unfortunately, the ^{228}Ac beta sources we prepared had higher activities than we expected. Measuring the source through alpha spectrometry revealed the presence of ^{224}Ra which apparently co-precipitates to some degree with CeF_3 . We thus decided to do a final clean up by introducing a TRU Resin column into the procedure to separate ^{228}Ac from ^{224}Ra and other possible interferences (^{214}Pb , ^{212}Bi , etc) (Figure 3).

There are several possible interferences in determination of $^{228}\text{Ra}/^{228}\text{Ac}$ which must be considered. Some of these include the natural decay-series nuclides (beta emitters) as ^{214}Pb , ^{214}Bi , ^{231}Th , and the artificial radionuclides as ^{90}Sr (^{90}Y), ^{90}Sr (^{89}Y). In order to check the efficiency of our decontamination process, an experiment was performed with samples which contained known levels of many of these potential interferences. The results of these measurements will be discussed in this presentation.

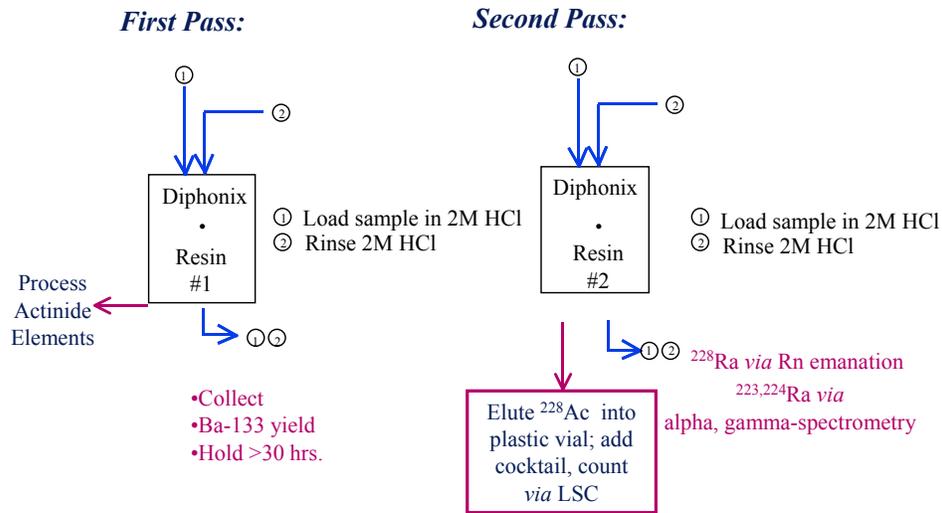


Figure 1. Schematic diagram of actinide separation using two Diphonix columns and LSC measurement of ^{228}Ac fraction.

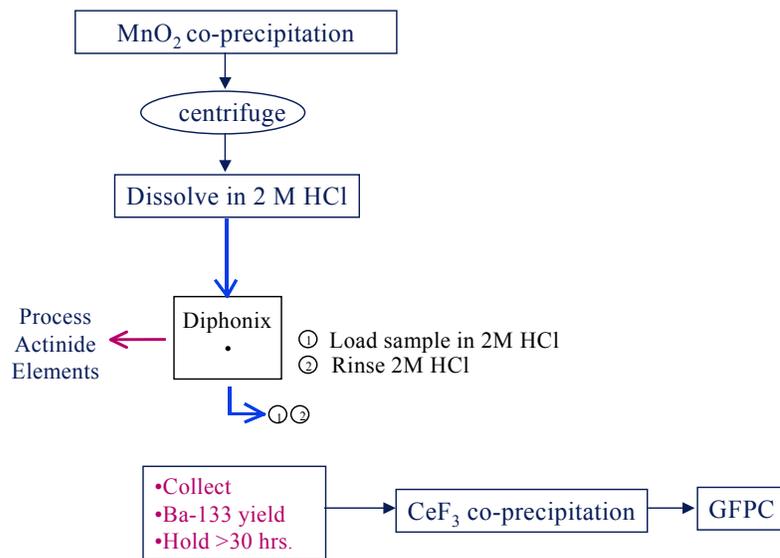


Figure 2. Schematic diagram of ^{228}Ra determination through actinides separation using Diphonix resin, and beta source preparation of ^{228}Ac for GFPC measurement.

